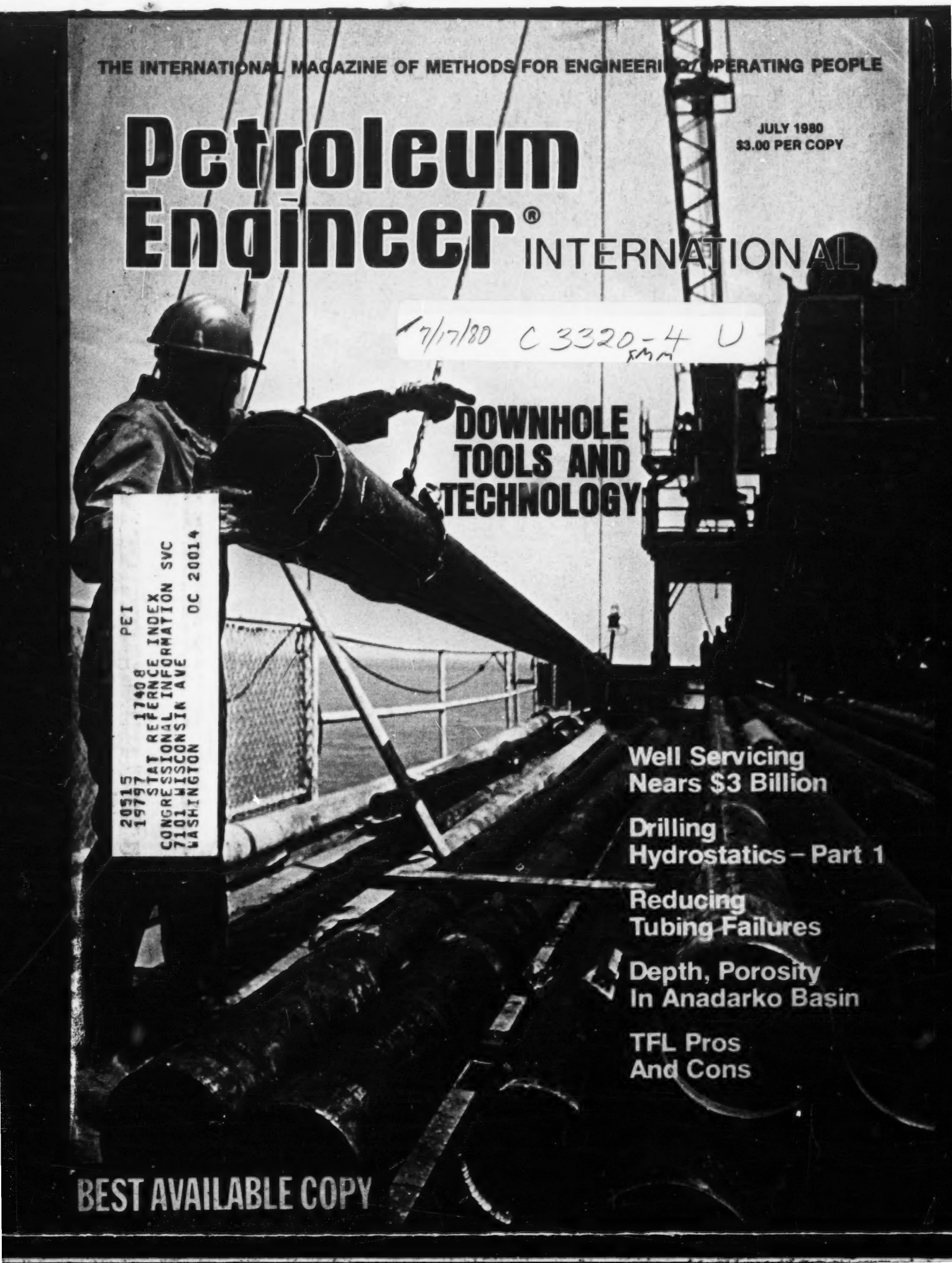

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ABOUT THE COVER: Hardware accounts for only part of the petroleum industry's soaring downhole costs. Research and development projects such as the ones described in this issue also are expensive, but they're aimed at improving efficiency and safety and, therefore, economics. (Photo courtesy of Pool Co.)

NEXT MONTH: A timely look at oilfield fluids technology in August will cover a lot of ground because just about every procedure in the oil patch involves a fluid of one type or another.

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TABLE 1. Completion, workover, servicing summary, by region

Region	Total wells	Completion, recompletion	Total art. lift	New lift installations	Lift repair	Tubular repair	Frac/acid stimulate	Steam/oil stimulate	Total $(M) budget
U.S.	692,743	55,710	492,069	12,658	383,318	75,858	19,319	9,833	3,472,666
Southeast	3,780	440	2,994	185	1,925	399	203	–	21,938
Great Lakes	67,828	7,809	51,499	1,050	14,600	4,800	500	–	40,150
Gulf of Mexico	2,718	1,001	973	84	118	182	126	–	427,988
Louisiana Onshore	33,107	4,730	19,643	1,647	18,831	1,693	739	3,260	323,500
Texas Onshore	218,123	16,693	162,753	3,323	152,510	29,379	5,935	982	779,970
Mid-Continent	154,171	13,052	133,305	4,315	134,768	26,602	6,300	–	525,728
Rocky-Williston	24,384	2,669	17,341	1,193	7,212	1,686	1,788	450	312,444
Four Corners	15,202	1,733	2,637	79	3,053	590	413	–	35,021
California Onshore	43,966	2,012	41,511	840	4,280	1,327	804	5,063	84,500
California Offshore	1,557	221	1,528	98	12	60	163	–	2,997

Inflation, Completions, Recompletions Boost Well Servicing To Near $3 Billion

A PETROLEUM ENGINEER INTERNATIONAL Staff Report

Oil and gas producers had, in late 1978, planned to spend slightly over $2 billion on well completions, servicing, and workover. But a lot of things have happened since that budget period ... some good and some bad. The bottom line is that total well servicing outlays for the U.S. reached $2,904,166,000 during 1979 (Table 1).

Producers expect to spend $3,617,281,000 during 1980.

Setting aside the inflation that equally hurts producers, rig contractors, and other vendors, there are good reasons for increased well service appropriations.

Completions, Recompletions Up

While Table 1 and Tables 5 through 15 illustrate various "typical" activities, the real story of 1979, 1980, and surely 1981 lies in Table 2. While exploration is active, development drilling outpaces exploration by more than 10 to 1. And recompletion of existing wells, in the same or new zones, runs close to new completions nationally and surpasses new completions in several areas.

Almost by definition, the recompletions are predominantly in shallow to medium wells ... that's what the older fields produce from.

In most parts of the country, well servicing contractors spend 30 to 50% of their time on the completions and recompletions. The majority of the contractors have the equipment and actively seek smaller (usually less than several hundred feet) well deepening jobs.

Artificial Lift

There were about 49,100 drilling efforts during 1979, which resulted in 19,478 oil completions and

TABLE 2. Completions and recompletions of exploration and development wells, by region

	Wells Dec. 31, 1979		New completions: Exploration		New completions: Development		Recompletions		
	Oil	Gas	Oil	Gas	Oil	Gas	Same zone	New zone	Abandons
U.S. Total	526,855	165,888	1,465	2,123	18,013	11,649	10,549	11,901	9,011
Southeast	3,085	695	39	38	118	84	70	91	84
Great Lakes	51,499	16,329	79	35	2,642	1,003	1,600	2,450	50
Gulf of Mexico	1,251	1,467	5	8	93	47	308	350	98
Louisiana Onshore	22,646	10,461	54	139	936	1,319	1,049	1,233	1,244
Texas* Onshore	181,883	36,240	554	1,221	6,560	3,098	3,010	2,250	1,755
Mid-Continent	128,535	25,636	492	313	4,511	1,996	2,492	3,248	2,772
Rockies-Williston	19,030	5,354	154	154	1,043	759	397	162	163
Four Corners	3,516	11,686	31	76	424	990	120	92	175
California Onshore	43,128	838	17	20	1,157	26	211	581	1,582
California Offshore	1,546	11	–	–	–	–	21	10	2

*Includes southeast New Mexico

TABLE 3. Oil and gas completions by depth and product, 1978 and 1979

Year	To 2,499 ft	2,500 to 4,999 ft	5,000 to 7,499 ft	7,500 to 9,999 ft	Deeper than 10,000 ft
1979	9,543	11,766	5,900	3,500	2,541
1978	9,715	11,124	5,751	3,303	2,376
Oil, 1979, %	66	58	55	61	39
Gas, 1979, %	34	42	45	39	61

13,772 gas wells. The half-million-plus older wells include many that were passing natural flow capability and were on artificial lift. So it is no surprise that the number of wells on artificial lift grew, from 452,322 in 1978 to 492,069 by the end of 1979. Of these, 436,632 of the artificial lift systems were on oil wells. The others are used, continuously or periodically, to lift fluids from gas producers.

If lift system manufacturers can keep up, growth in these numbers will probably be even more spectacular during 1980 and 1981. There are many very large redevelopment projects underway, some of which will nearly double field pump requirements. Amoco Production Co. alone has three large projects in and around Andrews County, Tex. Amoco's recent field expansions made it the largest net operator crude producer in Texas during 1979, and the company fully intends to broaden its lead. Meanwhile, Exxon, Chevron, Texaco, Shell, and several others are making sure Amoco earns every barrel of lead it keeps. The competition is a dream world for pumping unit suppliers.

Tubular Goods

For an unexplainable reason, survey responses indicate that casing repair jobs in 1979 were about half the number reported in 1978. But at the same time, tubing repair and replacement jobs occurred about three times as frequently (Table 4). Whatever the cause, the figures seem to indicate a need for better testing, inspection, and training practices.

Stimulations

The 1980 survey asked for numbers on steam or hot oil stimulation. Although this is largely a regional practice where more paraffinic crudes are produced, Table 1 shows that it is a popular remedy in south Louisiana, Texas' Austin Chalk trend, Southern California, and parts of the Williston Basin.

Not Too Deep

About two-thirds of completions in 1979 were at less than 5,000 ft and more than 90% were less than 10,000 ft (Table 3). Only in wells less than 2,500 ft did 1979 completions fail to surpass 1978 work.

The 684 deep projects in 1979 resulted in 621 completions – a 2.8% increase over 1978 deep well activity. Many producers, especially small to medium independents and majors with large developed holdings, prefer going after more oil. Statistically, wells deeper than 10,000 ft will be predominantly for gas. Below 15,000 ft gives a 78% chance to get gas ... if you get anything.

TABLE 4. Tubular goods repairs, by region, 1978 and 1979

	Casing				Tubing			
	1978		1979		1978		1979	
	Above 7,000 ft	Below 7,000 ft	Above 7,000 ft	Below 7,000 ft	Above 7,000 ft	Below 7,000 ft	Above 7,000 ft	Below 7,000 ft
U.S.	7,115	1,201	3,431	857	22,355	2,936	65,547	6,023
Texas	2,476	619	1,008	255	8,810	1,119	26,061	2,055
Louisiana	181	30	99	81	1,570	61	1,253	260
Mid-Continent	1,267	114	1,106	294	9,673	1,382	22,905	2,297
Rocky Mountains	192	105	354	77	314	157	846	409
California	1,388	36	66	5	1,335	170	1,205	51
Gulf of Mexico	4	19	–	–	10	14	56	126

TABLE 5. Total U.S. service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	7,697	1,313
Recompletions – same reservoir	8,640	1,909
Recompletions – different reservoir	9,447	2,454
Stimulation – acid or frac	15,064	4,255
Stimulation – steam	9,773	60
Tubing repair or replacement	65,547	6,023
Casing repair	3,431	857
Rod pump repair	159,362	14,461
Sucker rod work	176,697	15,251
New rod pump installation	8,034	1,439
Submersible pump repair	8,739	468
New submersible pump installation	1,339	194
Hydraulic pump repair	2,122	4,317
New hydraulic pump installation	307	299
Gas lift repair	974	927
New gas lift installation	790	256

TABLE 6. Southeast service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	42	42
Recompletions – same reservoir	49	21
Recompletions – different reservoir	56	35
Stimulation – acid or frac	56	147
Stimulation – steam/hot oil	–	–
Tubing repair or replacement	280	77
Casing repair	7	35
Rod pump repair	1,106	98
Sucker rod work	413	91
New rod pump installation	91	35
Submersible pump repair	35	42
New submersible pump installation	7	7
Hydraulic pump repair	42	70
New hydraulic pump installation	7	28
Gas lift repair	7	21
New gas lift installation	14	–

TABLE 7. Great Lakes (Michigan, Ohio, Indiana, Illinois) service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	50	–
Recompletions – same reservoir	1,600	–
Recompletions – different reservoir	2,450	–
Stimulation – acid or frac	500	–
Stimulation – steam/hot oil	–	–
Tubing repair or replacement	4,500	–
Casing repair	300	–
Rod pump repair	9,200	–
Sucker rod work	5,400	–
New rod pump installation	1,050	–
Submersible pump repair	–	–
New submersible pump installation	–	–
Hydraulic pump repair	–	–
New hydraulic pump installation	–	–
Gas lift repair	–	–
New gas lift installation	–	–

But well depth isn't much concern for service contractors in most parts of the country. Many rigs are overpowered for the work they are most likely to do. In deep well areas, there are usually more than enough rigs to handle the completion and servicing. The fact that a deep completion may take a month or two (and longer with problems) caused a few temporary inconveniences but nothing significant.

Rig Availability

There are now about 5,000 well servicing rigs with various capabilities in the U.S. Gross fleet additions are running at a rate of about 1½/day. Unfortunately, an estimated two rigs a month will be permanently or temporarily out of the fleet because of fires, blowovers, or other accidents. Perhaps a dozen will be cannibalized to keep other rigs working.

In what some people thought would improve availability, a trend developed to ship new rigs with integral lighting systems, or at least part of a lighting system. The idea of 24-hr operations is obviously

TABLE 8. Gulf of Mexico service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	70	28
Recompletions – same reservoir	28	280
Recompletions – different reservoir	112	238
Stimulation – acid or frac	70	56
Stimulation – steam/hot oil	–	–
Tubing repair or replacement	56	126
Casing repair	–	–
Rod pump repair	84	–
Sucker rod work	–	–
New rod pump installation	56	–
Submersible pump repair	14	–
New submersible pump installation	–	–
Hydraulic pump repair	–	6
New hydraulic pump installation	–	–
Gas lift repair	–	14
New gas lift installation	–	28

TABLE 9. Louisiana onshore service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	911	333
Recompletions – same reservoir	769	280
Recompletions – different reservoir	713	520
Stimulation – acid or frac	621	118
Stimulation – steam/hot oil	3,260	–
Tubing repair or replacement	1,253	260
Casing repair	99	81
Rod pump repair	11,769	90
Sucker rod work	5,478	330
New rod pump installation	983	121
Submersible pump repair	90	10
New submersible pump installation	89	4
Hydraulic pump repair	70	219
New hydraulic pump installation	–	30
Gas lift repair	423	352
New gas lift installation	290	130

more appealing to rig manufacturers than it is to contractors and producers. Although 24-hr service is fairly common in South Louisiana, in parts of the Rocky Mountains, and in a few other scattered deep-well areas, it has drawbacks.

Many producers don't have the personnel or the inclination for 24-hr work. Contractors can usually get warm bodies to handle two shifts now, but can't always find experienced hands for two shifts. Contractors who have undertaken intensive crew training to help them field two capable crews with each rig are finding that producers haven't kept pace. Servicing contractors are reluctant to run an expensive rig at night when the oil company's engineer is woefully short of experience. Most producers feel the same way, because their well is worth something too.

The consensus is that 24-hr capability is something to be reserved for deep wells and emergencies. There are, and will be, enough rigs to handle routine jobs during daylight hours.

There has been too much ado about rig concentration by Pool Co., WellTech Inc., NL Well Services, and CRC Petroleum Services. These large companies, with their financial strength, can and are doing many good things for the industry. But well servicing, along with most equipment and tools used in production, is bought at the local or district level. Independent contractors are also pretty strong, and hold their own, market and service-wise.

Improving Efficiency

To handle the more than 750,000 well servicing jobs annually with the manpower available to producers, rig contractors, and other service and supply companies requires good planning. Association of Oilwell Servicing Contractors President (until July) John Copeland is leading an effort by other contractors and some producer management to get improved planning and to include contractor people in the plan. A plan can't work unless everybody knows the plan, and that means improved communication is needed. Al-

TABLE 10. Texas onshore* service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	1,330	425
Recompletions – same reservoir	2,645	365
Recompletions – different reservoir	1,706	544
Stimulation – acid or frac	4,613	1,342
Stimulation – steam/hot oil	992	–
Tubing repair or replacement	26,061	2,055
Casing repair	1,008	255
Rod pump repair	51,245	6,917
Sucker rod work	79,163	8,690
New rod pump installation	2,085	495
Submersible pump repair	2,693	284
New submersible pump installation	400	62
Hydraulic pump repair	575	2,445
New hydraulic pump installation	106	90
Gas lift repair	403	95
New gas lift installation	65	20

*Includes southeast New Mexico and some wells in western Oklahoma operated from West Texas districts.

TABLE 11. Mid-Continent service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	2,520	252
Recompletions – same reservoir	1,960	532
Recompletions – different reservoir	2,562	686
Stimulation – acid or frac	5,194	1,106
Stimulation – steam/hot oil	–	–
Tubing repair or replacement	22,905	2,297
Casing repair	1,106	294
Rod pump repair	61,461	4,676
Sucker rod work	59,416	3,598
New rod pump installation	3,248	322
Submersible pump repair	4,102	28
New submersible pump installation	547	85
Hydraulic pump repair	616	504
New hydraulic pump installation	14	42
Gas lift repair	87	280
New gas lift installation	42	15

TABLE 12. Rocky Mountain-Williston Basin service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	102	61
Recompletions – same reservoir	253	144
Recompletions – different reservoir	78	84
Stimulation – acid or frac	906	882
Stimulation – steam/hot oil	450	30
Tubing repair or replacement	846	490
Casing repair	354	77
Rod pump repair	2,820	903
Sucker rod work	1,596	690
New rod pump installation	648	271
Submersible pump repair	462	47
New submersible pump installation	102	12
Hydraulic pump repair	133	553
New hydraulic pump installation	71	73
Gas lift repair	–	8
New gas lift installation	–	16

TABLE 13. Four Corners service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	161	14
Recompletions – same reservoir	98	22
Recompletions – different reservoir	77	15
Stimulation – acid or frac	336	77
Stimulation – steam/hot oil	–	–
Tubing repair or replacement	483	22
Casing repair	78	7
Rod pump repair	1,246	28
Sucker rod work	1,590	14
New rod pump installation	49	7
Submersible pump repair	133	–
New submersible pump installation	21	–
Hydraulic pump repair	–	–
New hydraulic pump installation	–	–
Gas lift repair	42	–
New gas lift installation	2	–

TABLE 14. California onshore service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	1,582	–
Recompletions – same reservoir	176	35
Recompletions – different reservoir	545	36
Stimulation – acid or frac	790	14
Stimulation – steam/hot oil	5,063	–
Tubing repair or replacement	1,205	51
Casing repair	66	5
Rod pump repair	1,229	6
Sucker rod work	2,350	–
New rod pump installation	541	15
Submersible pump repair	210	–
New submersible pump installation	12	–
Hydraulic pump repair	430	–
New hydraulic pump installation	72	–
Gas lift repair	–	55
New gas lift installation	184	16

TABLE 15. California offshore service jobs in 1979

	Less than 7,000 ft	Deeper than 7,000 ft
Abandoned (old wells)	2	–
Recompletions – same reservoir	21	–
Recompletions – different reservoir	10	–
Stimulation – acid or frac	163	–
Stimulation – steam/hot oil	–	–
Tubing repair or replacement	60	–
Casing repair	–	–
Rod pump repair	–	–
Sucker rod work	–	–
New rod pump installation	–	–
Submersible pump repair	–	–
New submersible pump installation	–	–
Hydraulic pump repair	–	–
New hydraulic pump installation	–	–
Gas lift repair	12	–
New gas lift installation	98	–

most universally, a crew will rig up without knowing what they are going to do or why. That's an invitation for lost time and accidents. But for a rig billing $160/hr, a 15 min safety and orientation meeting only costs $40. Future time savings will more than cover that, and the meeting could save a $250,000 or more well.

At the American Petroleum Institute meeting in Dallas in April 1980, there were a number of discussions about efficiency-communications problems when consultants acted for the producer. While many consultants are excellent oil men, some develop an air of bravado and insolence with their independence. Like humans everywhere, an angry rig crew is slow and dangerous.

Conclusions

Because of uncertainty over government policies and actions, producers were probably a little too conservative when preparing 1979 budgets. As the year unfolded, most producers significantly increased their activities. But while the federal energy policy (?) began favoring domestic production, monetary policy caused havoc with budgets. The results were that producers, servicing contractors, and other vendors were working harder and handling larger cash flows.

Because so many development and redevelopment projects are still new or still underway, it is impractical to try to forecast, in terms of future oil and gas, how successful the recent flurry of activity will be. Such forecasts may be more realistic by the time PETROLEUM ENGINEER INTERNATIONAL does its 1981 well servicing survey. ■

Data presented was based on PETROLEUM ENGINEER INTERNATIONAL's 1979 Well Service Survey. Responses came from 197 independent and integrated companies and regional managers. Appropriate base data used for projections was corroborated with data published by API and Petroleum Information Corp.